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Normal faults and thrusts re-activated by deep fluids: the 6 April 2009 Mw 6.3 L'Aquila earthquake, central Italy.

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On April 6 2009, a Mw=6.3 earthquake occurred in the central Apennines (Italy). We relocate the October 2008-April 6 2009 foreshocks and about 2000 aftershocks occurred between April 6 and April 30 2009, by applying a double-difference technique and determine the stress field. The events concentrate in the upper 15 km of the crust. NW-SE to NNW-SSE striking, 30°-45° and 80°-90° dipping faults activate during the seismic sequence. Among these, a normal fault and a thrust were re-activated with dip-slip movements in response to NE-SW extension. The structural maturity of the seismogenic fault system is lower than that displayed by other systems in southern Apennines, because of the lower strain rate of the central sector of the chain with respect to the southern one. VP/VS increases progressively from October 2008 to the April 6 2009 mainshock occurrence along a NW-SE strike due to an increment in pore fluid pressure. Pore pressure diffusion controls the space-time evolution of aftershocks and a hydraulic diffusivity of 80 m2/s and a seismogenic permeability of about 10-12 m2 suggest the involvement of gas-rich (CO2) fluids. Suprahydrostatic fluid pressure within overpressurized traps bounded by pre-existing structural and/or lithological discontinuities are required to activate the seismic sequence. Traps are the storage zone of CO2-rich fluids uprising from the underlying, about 20 km deep, metasomatized mantle wedge. In the Apennines, fluids may activate faults responsible for earthquakes up to Mw=5-6. Deep fluids more than tectonic stress may control the seismotectogenesis of accretionary wedges.